SOUTHERN FOOTHILLS MOOSE SURVEY AND POPULATION ANALYSIS

(WMUs 302-306 & 308)

January/February 2002

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ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT

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Abstract

A moose population census was conducted in the southern foothills (WMUs 302, 304, 305, 306 and 308) over four days beginning in late January 2002, following a stratified habitat sampling technique developed for the area in 1991. Moose population size calculated using pooled data for the entire area was 1322 individuals with a precision of ± 21%. Population size and bull and calf per 100 cow ratio were estimated for each wildlife management unit (WMU). The WMU 302 population estimate was 271 moose with a bull:100 cows: calf ratio of 53:100:34. For WMU 304 the population was 780 with a bull:100 cow: calf ratio of 34:100:41. WMU 305 had a population of 17 moose; sex/age ratios could not be calculated for this WMU due to a low sample size. WMU 303 and 306 had a combined population of 174 individuals with a bull:100 cow: calf ratio of 47:100:67. In WMU 308 there was a population of 285 moose with 29 bulls:100 cows: 43 calves. Precision of estimates for individual WMU's was poor, ranging from ± 40-65%.

Acknowledgements

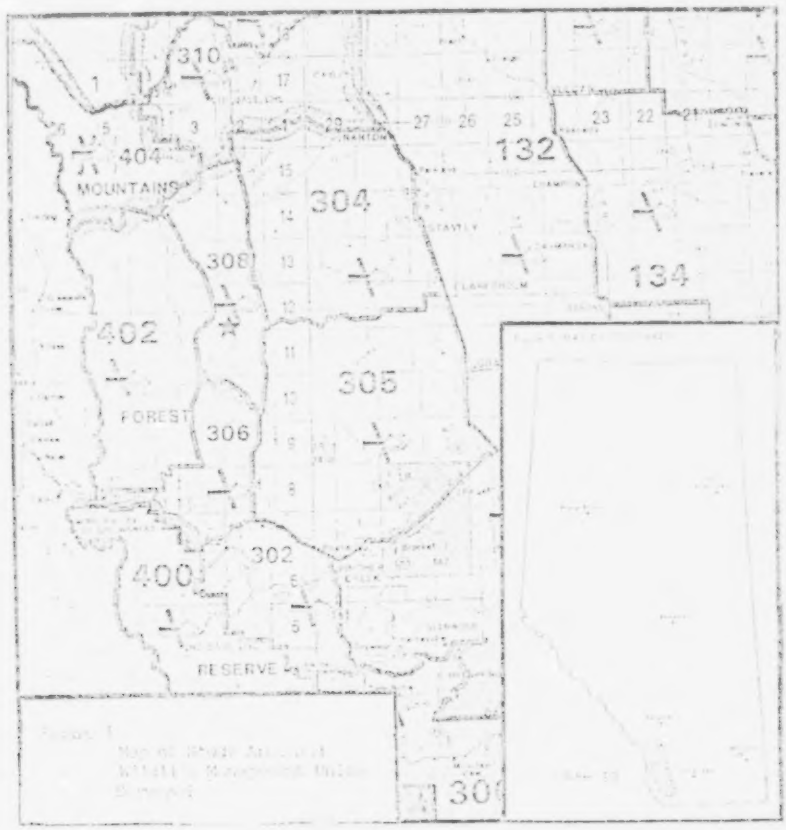
The author would like to thank observers Jim Clark, Darren Dorge, Wayne Norstrom, Christy Pawliuk, Mike Taje, Rob Watt, Daryl Wig, and Bighorn Helicopters' pilots Greg Goodison and Trevor Mitchell for their contributions to the survey. Appreciation is also extended to the Blairmore Ranger Station, Chain Lakes Provincial Park, and Al Heschl for use of helicopter landing facilities and fuel caches. Jim Clark provided useful review comments.

Introduction and Program Objectives

Moose population surveys in south-west Alberta are generally carried out every second year, weather and funds permitting. Poor weather prevented a survey from taking place in the winter of 2000; thus, the area was long overdue for documentation of the status of moose populations in Wildlife Management Units (WMU's) 302, 304, 305, 306 and 308. Since 1991, a stratified habitat sampling technique developed by Gudmundson (1991) and modelled after the Gasaway et al. survey method (1986) by has been employed (Quinlan 1994, 1996, 1998). Program objectives included the documentation of habitat-specific densities, seasonal distribution and sex/age ratios of moose, and the estimation of moose population size for each WMU and the total area.

Census Area

This moose population census included WMU's 302, 303, 304,305, 306 and 308. These areas include the Porcupine Hills, Chain Lakes/Whaleback area, Crowsnest Pass, and south through the Carbondale River area to Peeten (Shell Canada gas refinery). In addition, a WMU 400 trend survey was flown in the Castle River area. The landscape comprises montane foothills with the Livingstone Range and Blairmore Range bordering on the west (Fig. 1)



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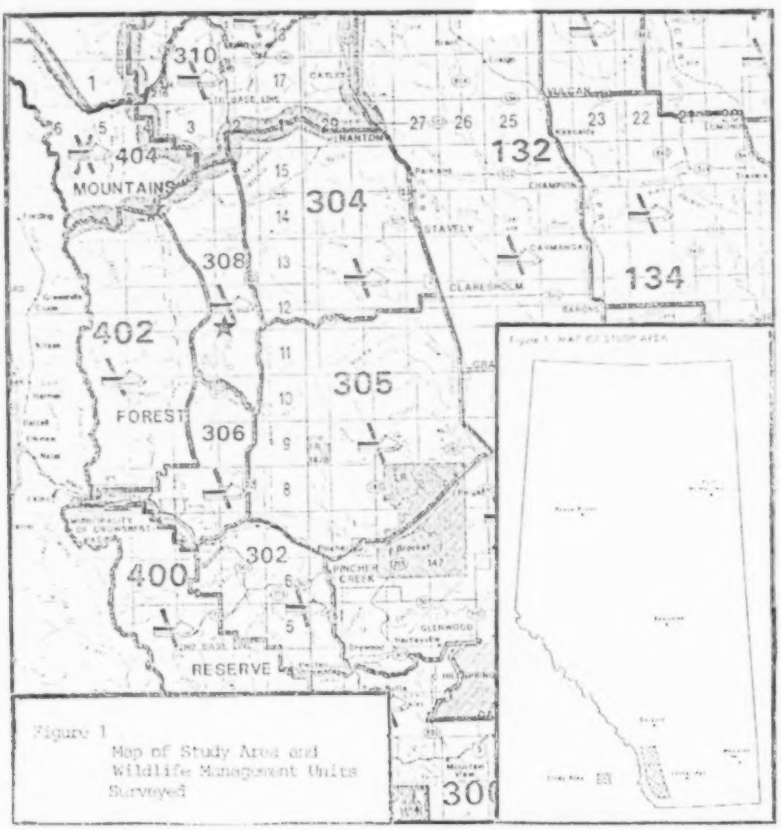

Figure 1
Map of Study Area and Wildlife Management Units Surveyed

Methodology

a) Moose Habitat Stratification

Habitat stratification was carried out prior to the first stratified 1991 survey at a scale of 1:20,000 (Gudmundson 1991). Moose habitat was allocated to five stratum:

Stratum 1 - Shrub-land - Comprising ≥ 70% broad-leaved shrub cover.

Stratum 2 - Broad-leaved Deciduous Forest - Comprising ≥ 70% deciduous tree cover.

Stratum 3 - Broad-leaved Shrub Cover/Deciduous Forest - Interspersed stands of broad-leaved shrub-cover and deciduous forest of nearly equal proportions.

Stratum 4 - Mixed Wood Forest – Comprising nearly equal proportions of coniferous and deciduous trees.

Stratum 5 - Coniferous Forest – Comprising ≥ 70% coniferous tree cover.

Habitat strata were sub-divided into survey unit blocks ranging in size from approximately 1.5 to 5.5 km^2. Roads, creeks, fences or vegetation edges were used as survey block boundaries. Approximately 20% of the areas for Strata 1, 2, 3 and 4, and 10% of Stratum 5 was surveyed.

b) Aerial Survey

The survey was conducted with a Bell 206 helicopter at an altitude of 75-150 meters above ground level, with air speeds ranging from 80-120 km/hr. Each sample block was systematically surveyed with 100% coverage. Two observers occupying the rear seats of the helicopter provided continuous side observation while the navigator provided front observation, and maintained the proper flight course. The rear right observer was responsible for recording of data.

All moose observed were classified by age (calf or adult) and sex. Adult moose were sexed by the presence or absence of a white vulva patch or the presence of antlers. Calves were

identified by body size and facial features. Only those animals observed within sample blocks were considered for density calculations. Animals observed outside sample blocks were included in WMU calculations of bulls/100 cows/calves. Through application of the Alberta Fish & Wildlife Division Quadrant Survey software upper and lower population limits were developed for each WMU.

Results

The survey was conducted over 4 days from January 28 to February 1, 2002. January 31 was not flown due to severe wind conditions. Two helicopters and observation crews were used to take advantage of the short window available for good flying conditions.

Two methods were used to derive an overall population estimate for the total sampling area. First, pooling of all survey data in the analysis (Appendix 1) revealed a population estimate for moose in WMU's 302, 303, 304, 305, 306 and 308 of **1322 ± 274** individuals (estimate ± 90% confidence interval). Second, simple addition of individual WMU estimates (Table 1) resulted in a total of 1346 individuals, with no accompanying estimate of error. However, it should be noted that this second procedure is less statistically rigorous since each individually-derived estimate has an associated error that is compounded by adding all estimates together, whereas the pooling of data leads to greater precision. The second, less precise method was calculated only for the reason that this is the way it has been done for a number of years, and it was desirable to compare this year's estimate with previous years. However, the former estimate provides the most rigorous estimate, along with an estimate of error, which has never been calculated previously for the entire population.

Table 1. Moose population estimates by Wildlife Management Unit and total area. Blank cells indicate insufficient data were collected to run statistical analyses. Ratios are calculated from moose classified both on and off survey blocks.

Wildlife Management Unit	Population estimate	Lower 90% CI	Upper 90% CI	Bulls: 100 cows: calves	Observed on Survey			
					Bulls	Cows	Calves	Unclassified
302	271	160	383	53:100:34	25	47	16	1
303	35	NA	NA	NA	1	2	2	1
304	598	402	794	34:100:41	25	74	30	1
305	17	NA	NA	NA	1	2	0	0
306	140	NA	NA	46:100:62	6	13	8	0
308	285	170	401	29:100:43	8	28	12	0
303/306 pooled	174	59	289	47:100:67	7	15	10	1
Pooled	1322	1047	1596	40:100:41	66	166	68	3

Moose populations in WMUs 302 and 304 increased since the previous 1998 survey (Fig. 2). It should be noted that in one survey block in WMU 304 (Block A), an exceptional number of moose were counted (37). The inclusion of this block in the population estimate disproportionately affected the value (598 moose vs. 780 moose with block included); in addition, a navigational error resulted in the area south of the original block being surveyed. A decision was made to drop Block A in WMU 304 from the analysis (as well as from the pooled overall analysis (1322 moose vs. 1510 moose with block included).

In contrast to the increase seen in WMU's 302 and 304, the population in WMU 308 showed a marked decline in numbers. Populations in all other WMUs have remained relatively constant since the last survey period.

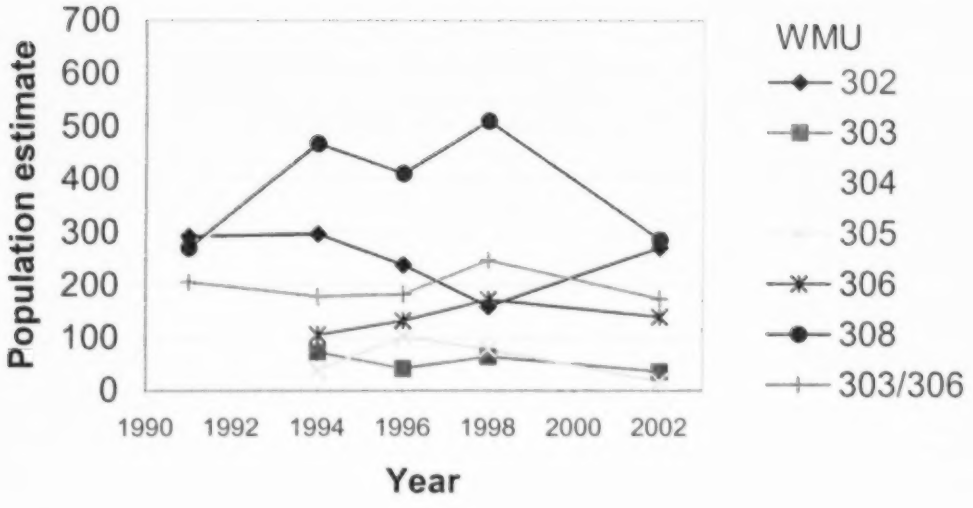

Figure 2. Moose population trends in each WMU, 302-308, 1991-2002.

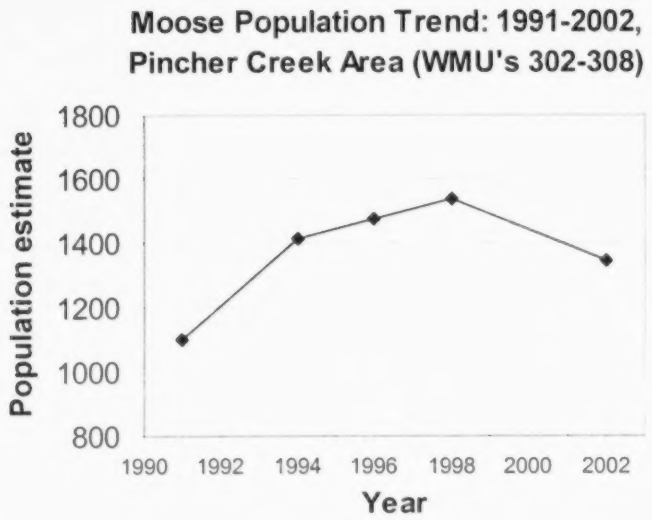

Figure 3. Moose population trends in WMU's 302-308, Pincher Creek area.

Overall, moose density was the highest in the Shrub-land (Stratum 1), followed by the Broad-leaved deciduous habitat type (Table 2). Lowest moose densities were observed in Coniferous Forest (Stratum 5). Habitat-specific densities within each WMU are listed in Appendix 2.

Table 2. Habitat-specific moose densities averaged across all survey blocks within a stratum.

Habitat Stratum	Mean moose density (moose/km^2)	Standard deviation	# Sample Blocks Flown
1 Shrub-land	2.1	1.67	8
2 Broad-leaved Deciduous Forest	1.9	2.29	23
3 Broad-leaved Shrub Cover/Deciduous Forest	1.6	0.17	2
4 Mixed Wood Forest	0.8	1.04	22
5 Coniferous Forest	0.2	0.39	23

a) Wildlife Management Unit 302

A total of 89 moose (25 bulls, 47 cows and, 16 calves and 1 unidentified) were observed in WMU 302 (Table 1). By relating habitat specific densities to total representative range, a winter population of 271 ± 41% moose is estimated for WMU 302 (Table 1).

Based on a sample of moose, including animals observed "off blocks" and on the WMU 400 migration trend transect, bull and calf ratios/100 cows were 53 and 34 respectively (Table 1). Approximately 2.6 hours of flying time were required to complete the survey in WMU 302. This included dead-heading time between sample blocks. Observers did not record time for other WMU's.

A total of 41 moose (11 bulls, 19 cows, 10 calves and 1 unclassified) were observed on the WMU 400 migration trend transect established in the vicinity of the Castle River within the Bow Crow Forest Reserve (Figure 4). Approximately 1.5 hours of flying time was used to complete the WMU 400 trend block.

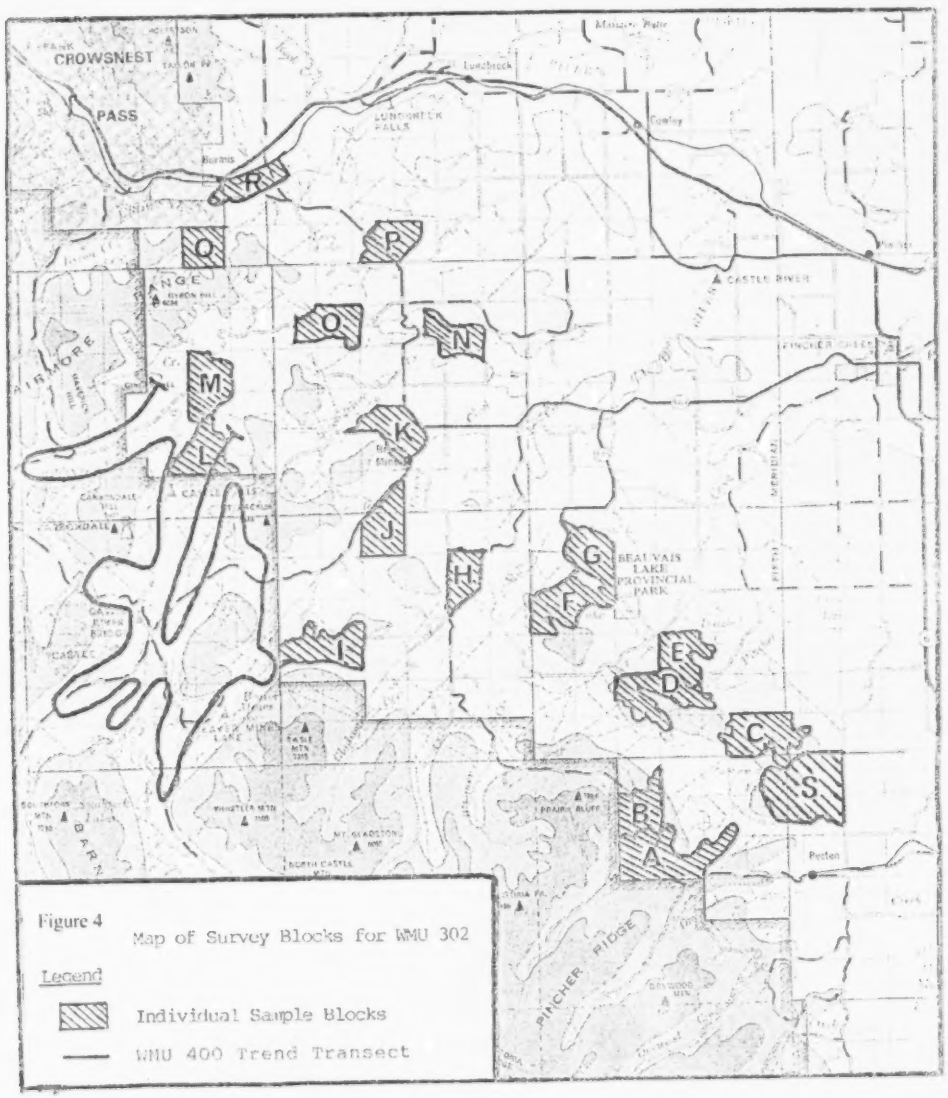

Figure 4 Map of Survey Blocks for WMU 302

Legend

Individual Sample Blocks

WMU 400 Trend Transect

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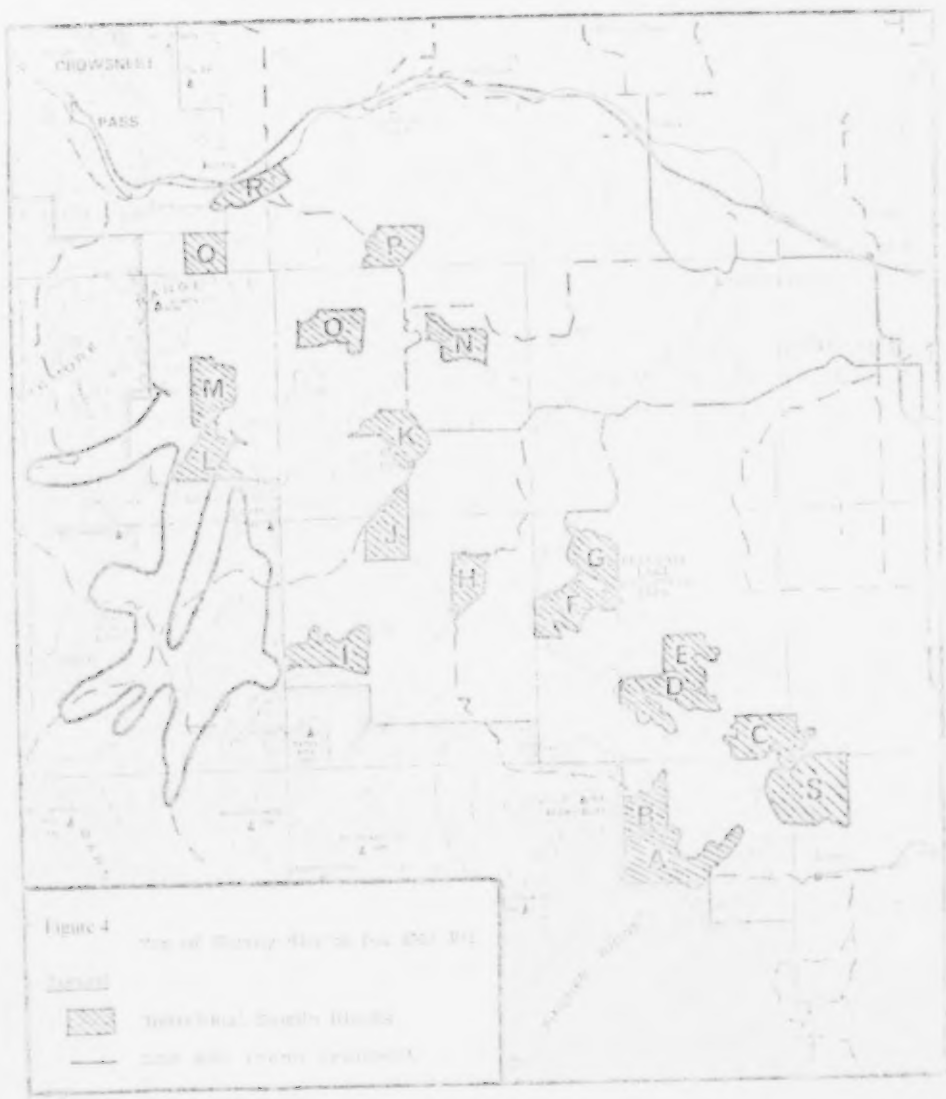


Figure 4

b) Wildlife Management Unit 303

A total of 6 moose (1 bull, 2 cows and, 2 calves and 1 unidentified) were observed in WMU 303 (Table 1). By relating habitat specific densities to total representative range, a winter population of 35 moose is estimated for WMU 302 (Table 1). No error could be calculated on this estimate.

Flying times to complete 303 were not recorded.

c) Wildlife Management Unit 304

A total of 130 moose (25 bulls, 74 cows, 30 calves and 1 unidentified) were observed in WMU 304 (Table 1). By relating habitat specific densities to total representative range, a winter population of 598 ± 33% moose is estimated for WMU 304 (Table1). Bull and calf ratios/100 cows were 34 and 41, respectively (Table 1).

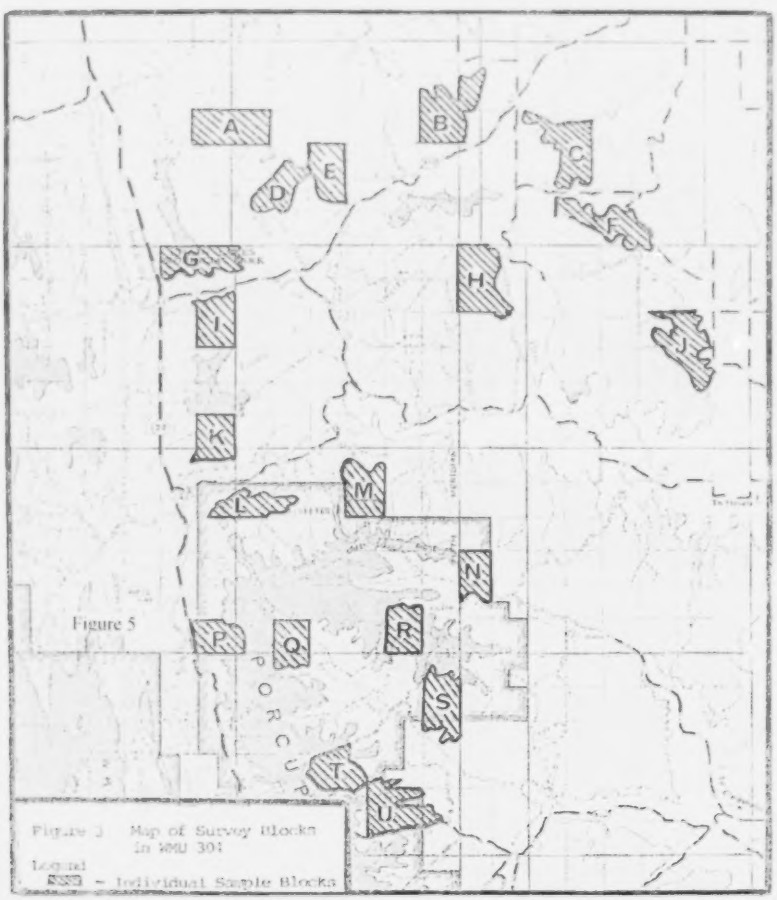


Figure 5

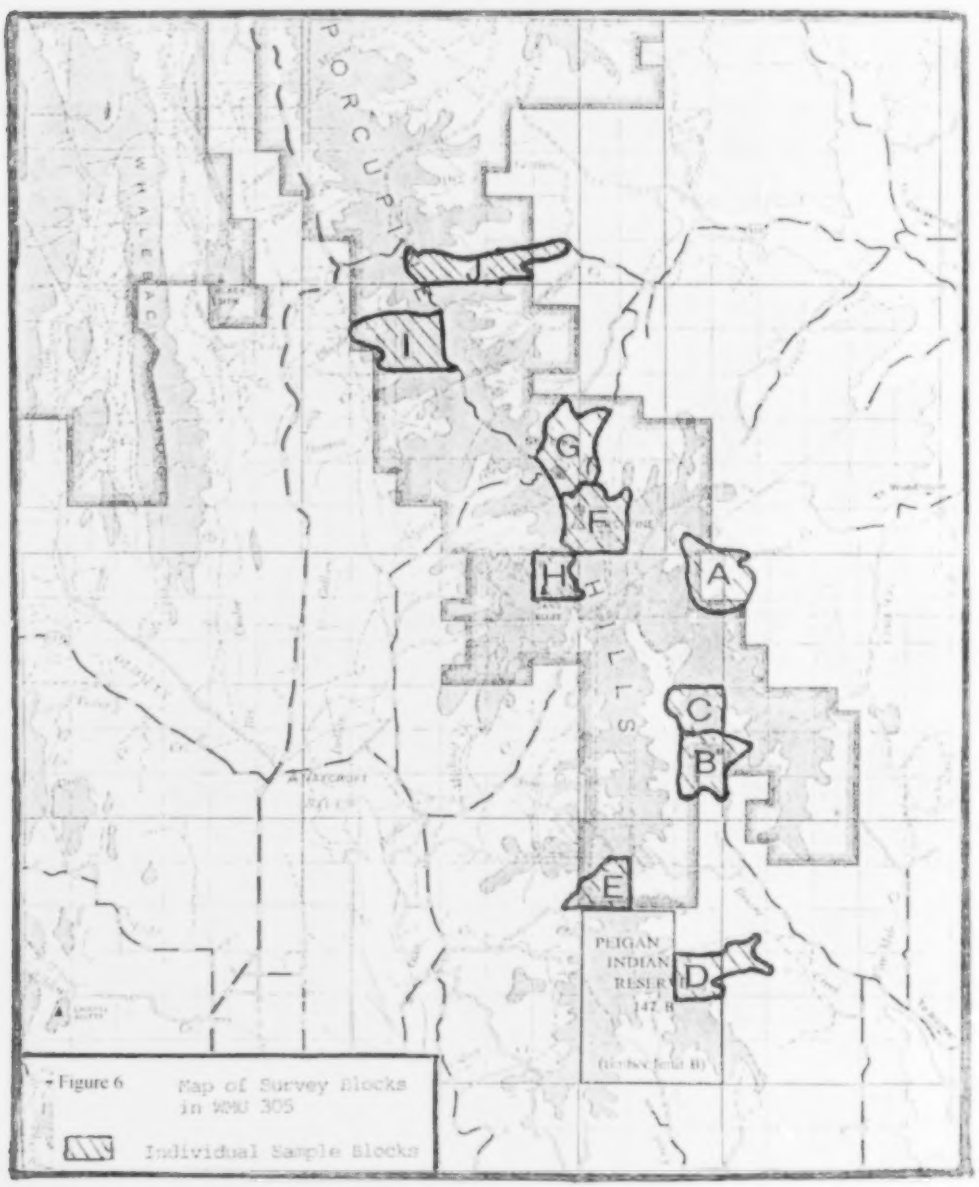
Figure 5 Map of Survey Blocks in WMU 304

Legend
SSS = Individual Sample Blocks

d) Wildlife Management Unit 305

A total of 3 moose (1 bull, 2 cows) were observed in WMU 305 (Table 1). By relating habitat specific densities to total representative range, a winter population of 17 moose is estimated for WMU 305 (Table 1). No error could be calculated on this estimate.

Bull and calf ratios/100 cows could not be calculated due to lack of sample size.



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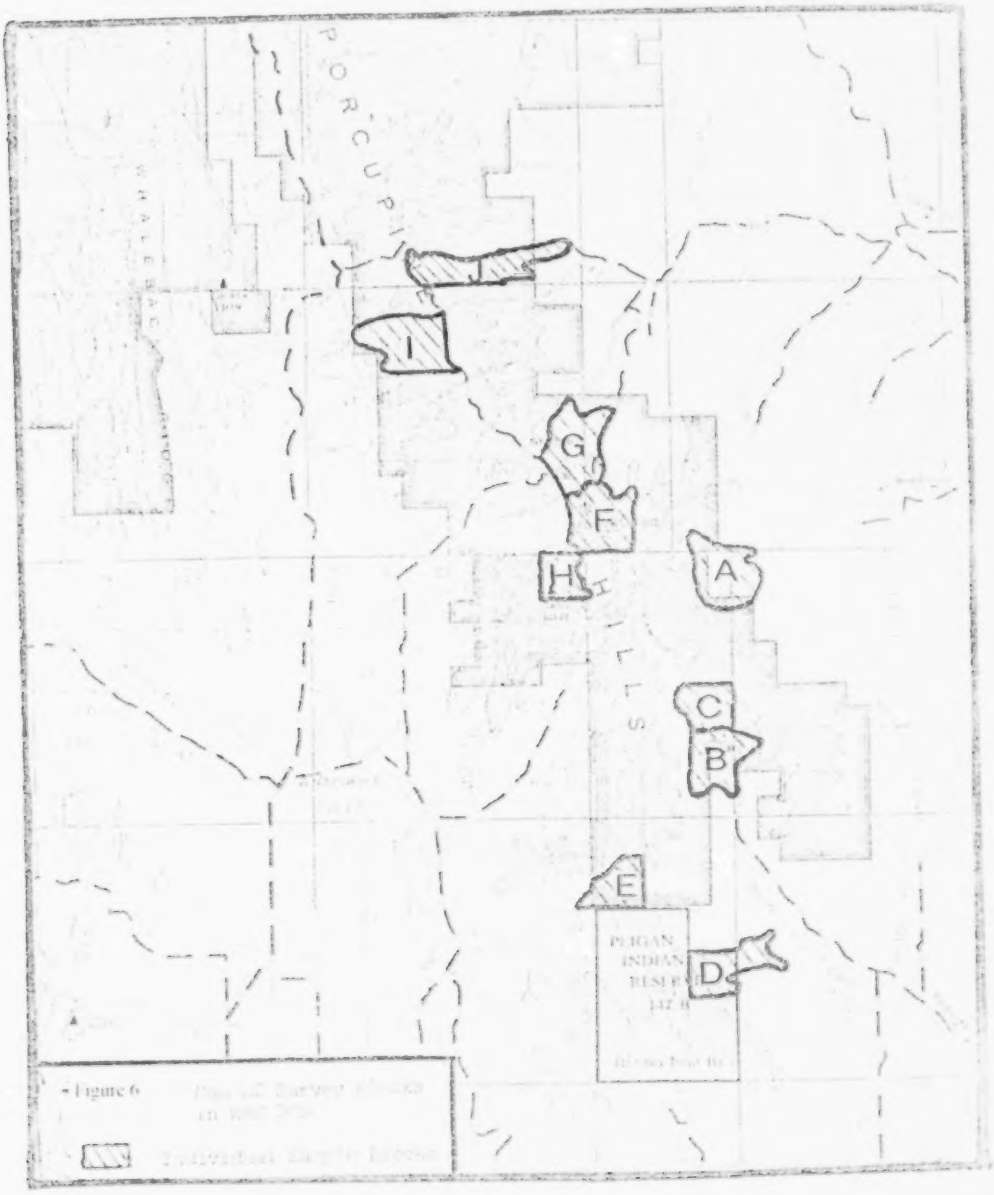
d) Wildlife Management Unit 305

A total of 3 moose (1 bull, 2 cows) were observed in WMU 305 (Table 1). By relating habitat specific densities to total representative range, a winter population of 17 moose is estimated for WMU 305 (Table 1). No error could be calculated on this estimate.

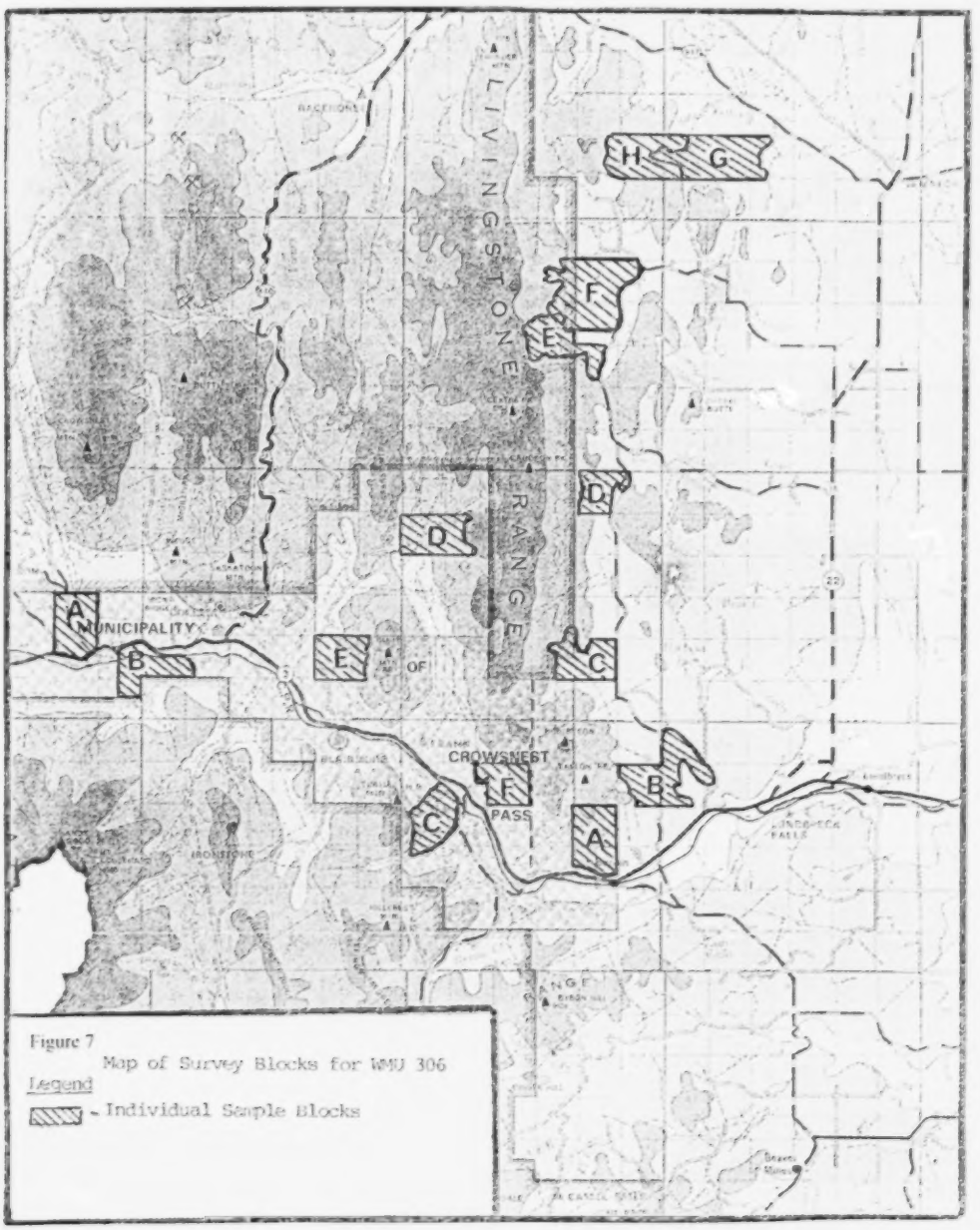
Bull and calf ratios/100 cows could not be calculated due to lack of sample size.



e) Wildlife Management Unit 306

A total of 27 moose (6 bulls, 13 cows and, 8 calves) were observed in WMU 306 (Table 1). By relating habitat specific densities to total representative range, a winter population of 140 moose is estimated for WMU 306 (Table 1). No error could be calculated on this estimate.

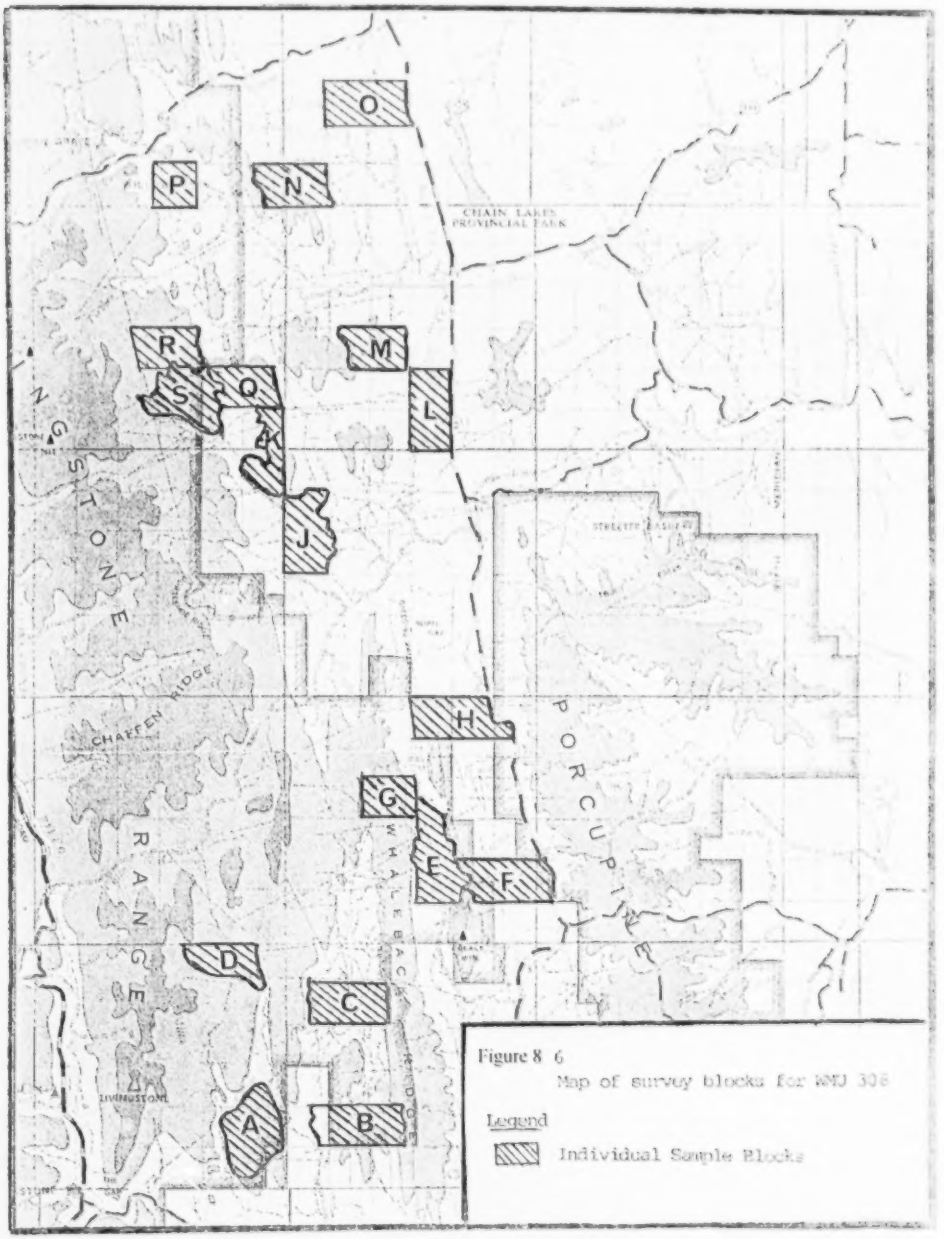
Bull and calf ratios/100 cows were 46 and 62 respectively (Table 1).



f) Wildlife Management Unit 308

A total of 48 moose (8 bulls, 28 cows and 12 calves) were observed in WMU 308 (Table 1). By relating habitat specific densities to total representative range, a winter population of 285 ± 40% moose is estimated for WMU 308 (Table 1).

Bull and calf ratios/100 cows were 29 and 43 respectively (Table 1).



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A total of 27 moose (6 bulls, 13 cows and, 8 calves) were observed in WMU 306 (Table 1). By relating habitat specific densities to total representative range, a winter population of 140 moose is estimated for WMU 306 (Table 1). No error could be calculated on this estimate.

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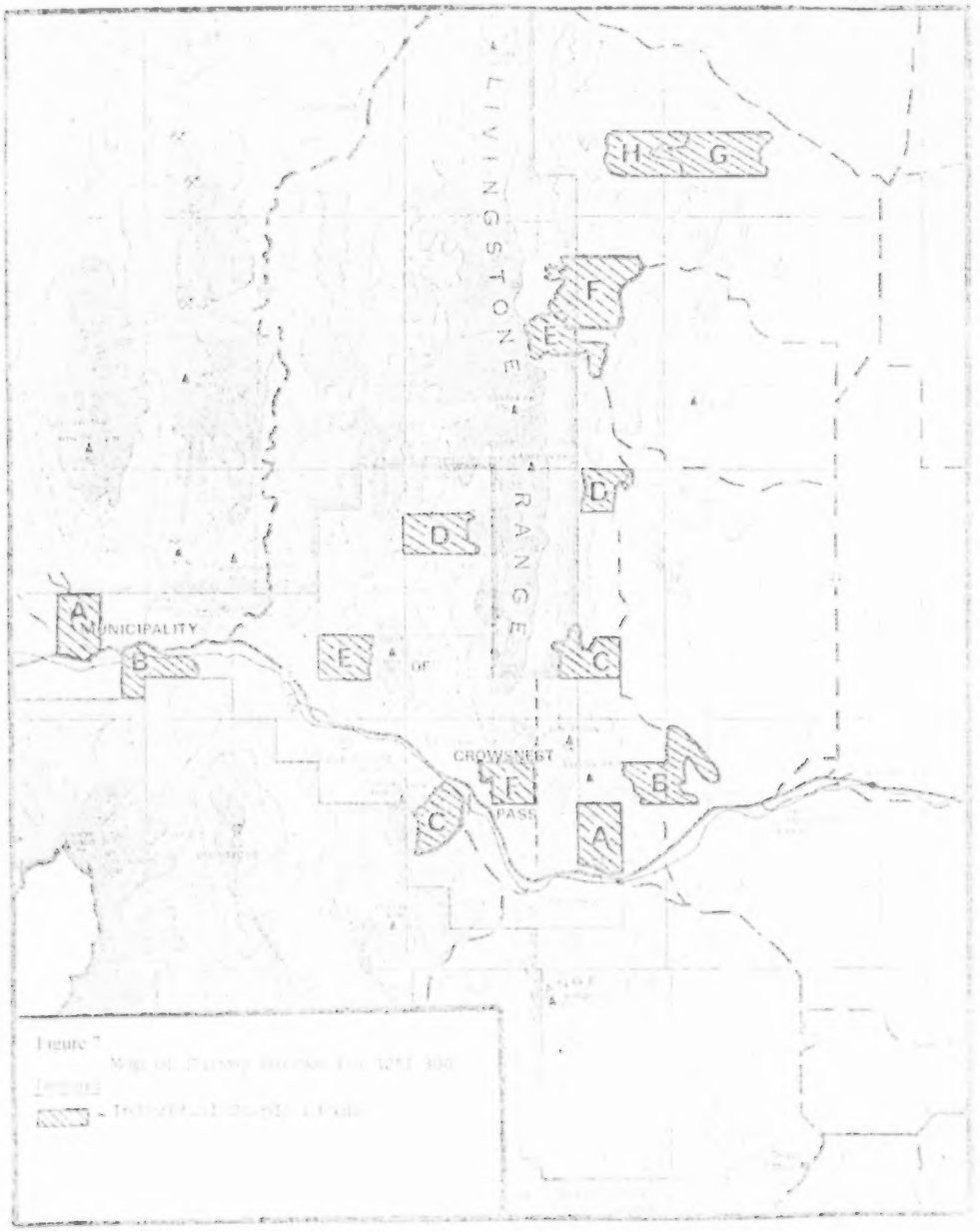

Figure 7

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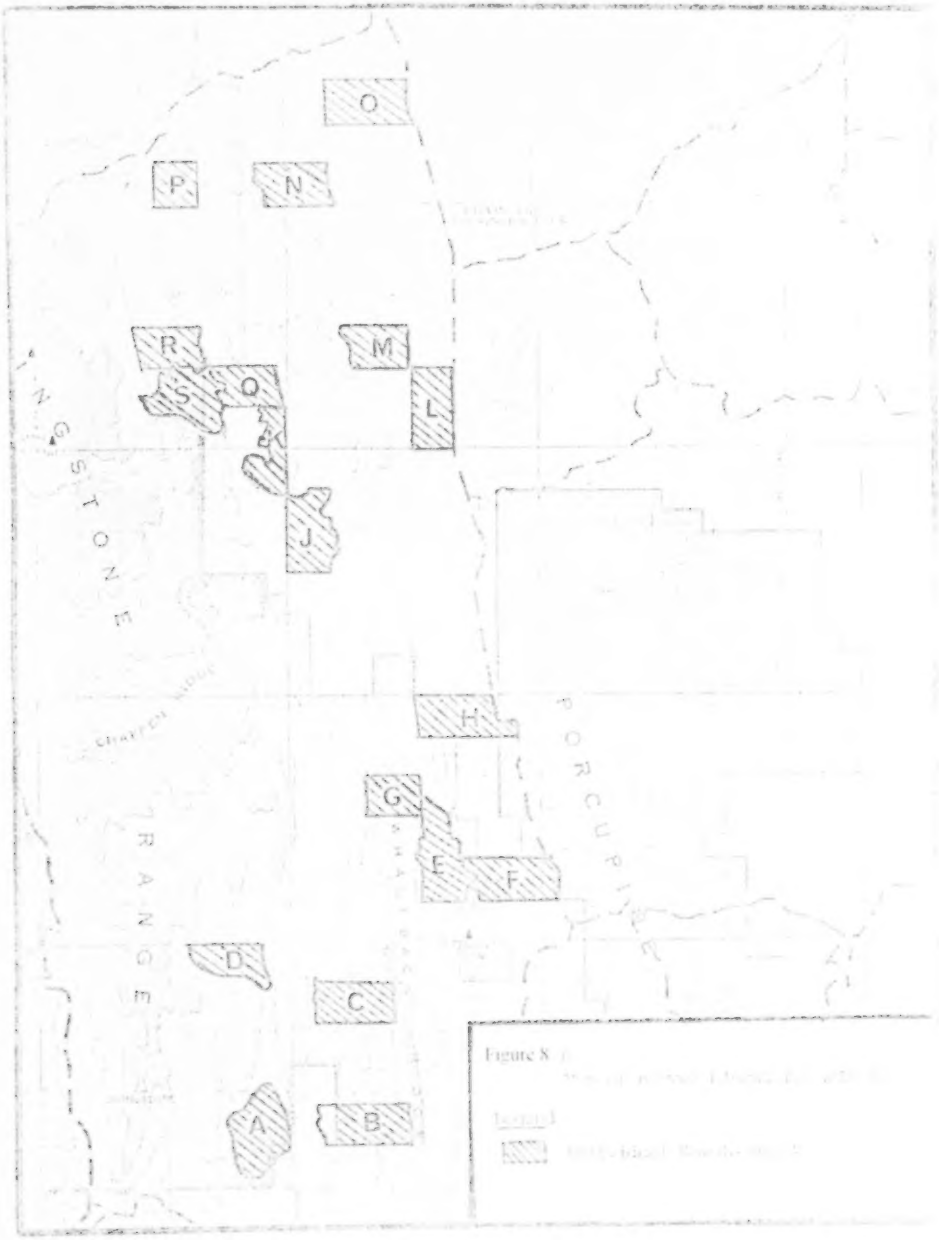

Discussion

Overall

The 2002 population estimate of 1322 for the complete survey area (WMUs 302, 304, 305, 306, 308) was slightly lower than the 1998 estimate of 1537. Although no measure of error was calculated for the 1998 estimate, it is unlikely that it is any better than the 21% error achieved on the 2002 estimate. Thus, the two estimates are not significantly different, in the statistical sense.

A total of 300 moose observed both on and off survey blocks were classified to sex and age. They comprised of 66 bulls, 166 cows, and 68 calves resulting in an overall bull:100 cow:calf ratio of 40:100:41 (Table 1). These are relatively high values for bulls, and moderate for calves, suggesting that the harvest rate of bulls is sustainable, and that a small antlerless hunt may be possible.

WMU 302

The WMU 302 estimate may have been influenced by timing of the survey relative to moose migration. There is believed to be a winter movement of moose from the mountains (WMU 400) into the foothills (WMU 302). Prior to the survey there had been several weeks of cold weather and snow and it was expected that the animals would move well out into their winter habitat. The WMU 400 trend survey showed that this was not entirely the case, as 41 moose were observed compared to about half this number in 1994 and previous surveys. It is therefore likely that the winter population estimate of 271 moose for WMU 302 is somewhat lower than if the survey had been flown 2 or 3 weeks later. Overall, the WMU 302 population appears to have reached a leveling off of numbers, suggesting this population may be near carrying capacity, and could sustain a small anterless harvest.

Bull ratios in WMU 302 were good at 53:100 cows compared to 39:100 cows in 1998; however, this is still lower than the 82 bulls:100 cow ratio of the 1994 survey. This pattern may simply be a result of the relatively higher numbers of moose seen in the trend block survey in 2002, compared with fewer seen in 1994. Calf ratios were slightly better than in 1998 with 34:100 cows, compared with 22:100 in 1998.

WMU 304

WMU 304 had the highest density of moose (1.8/km^2) recorded since regular surveys were initiated in 1982, slightly higher than that observed in 1998. The northern end of the Porcupine Hills has excellent moose habitat, with large areas of shrub habitat utilized by the resident moose throughout the winter. Also, high hunting pressure and wolf activity in the northern part of WMU 308 may have caused some moose to shift their range to WMU 304. It is possible that the patchiness of predator distribution may lead to shifting and uneven prey distribution.

Whereas bull:100 cow ratios in WMU 304 increased to 34:100 cows from the perennial 15-20:100 level of the past; calf:100 cow ratios were still lower than the high of 71:100 of 1994. It would appear that the North Porcupine Hills moose population is leveling after a period 10% annual population increased experienced in the early 1990s.

WMU 306

In WMU 306 there has been a stable population since 1991. This has occurred under a harvest regime that should have allowed a population increase. The moose density of 1.1. moose/km^2 observed in 2002 is similar to densities observed in the early 1970's and 1980s, with the

exception of 2.2 measured in 1979-80 (Appendix 3). There appears to be good productively (62 calves:100 cows). The lack of population increase would suggest that natural mortality is balancing with reproduction, a sign that the population may be at or near carrying capacity. A small anterless hunt in WMU 306 may be possible.

WMU 308

The population in WMU 308 declined from about 500 moose in 1998 to less than 300 in 2002. It must be remembered, however, that the confidence intervals are wide, making the conclusion that a decline was observed difficult to make. Traditionally, native harvest in this area (especially the more roaded north) has been high. Also, active wolf packs may have caused a shift in moose distribution, possibly accounting for the slightly higher numbers in WMU 304. Continuation of a limited bull hunt without an antlerless licence is recommended.

References

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Appendix 1. Sample block areas and 2002 moose counts for each WMU and habitat stratum. Blocks missed during the survey flights are indicated.

WMU	Stratum	Block	Area (km^2)	Bulls	Cows	Calves	UI	Total moose	Density (moose/km^2)
302	2	B	2.46	1	2	1	0	4	1.6
302	2	C	3.21	1	1	1	0	3	0.9
302	2	K	1.74	0	3	0	0	3	1.7
302	2	N	1.48	0	0	0	0	0	0
302	2	O	1.92	4	8	0	0	12	6.2
302	2	R	1.68	0	0	0	0	0	0
302	2	S	2.63						Missed on survey
302	4	A	3.03	0	0	0	0	0	0
302	4	E	2.87	0	0	0	0	0	0
302	4	G	2.49	0	1	0	0	1	0.4
302	4	H	2.18	0	1	1	0	2	0.9
302	4	I	2.48	0	1	0	0	1	0.4
302	4	J	2.43	4	1	0	0	5	2.1
302	4	M	2.15	2	4	1	0	7	3.3
302	4	P	1.99	0	2	0	0	2	1
302	5	D	3.06	0	0	0	0	0	0
302	5	F	3.32	1	1	0	0	2	0.6
302	5	L	3.13	1	2	2	0	5	1.6
302	5	Q	2.28	0	1	0	0	1	0.4
303	4	C	3.68	0	1	1	0	2	0.5
303	5	A	2.68	0	0	0	0	0	0
303	5	B	2.33	0	1	1	0	2	0.9
303	5	D	3.84	1	0	0	1	2	0.5
303	5	E	2.96	0	0	0	0	0	0
303	5	F	3.3	0	0	0	0	0	0
304	1	A	2.48	17	15	5	0	37	Omitted from analysis
304	1	B	2.25	0	1	1	0	2	0.9
304	1	C	2.93	0	6	4	0	10	3.4
304	1	E	2.52	1	8	5	0	14	5.6
304	1	J	3.29						Missed on survey
304	2	D	2.41	0	4	1	0	5	2.1
304	2	G	3.18	0	3	2	0	5	1.6
304	2	H	3.8	1	3	1	0	5	1.3
304	2	I	3.29	0	0	0	0	0	0
304	2	K	3.94	1	2	1	0	4	1

WMU	Stratum	Block	Area (km^2)	Bulls	Cows	Calves	UI	Total moose	Density (moose/km^2)
304	2	M	2.68	0	16	5	0	21	7.8
304	2	N	2.29	1	2	0	0	3	1.3
304	2	U	3.72	0	3	1	0	4	1.1
304	3	F	3.34	0	4	1	0	5	1.5
304	3	O	2.3	1	2	1	0	4	1.7
304	4	L	2.83	2	0	0	1	3	1.1
304	4	P	3.22						Missed on survey
304	4	S	3.96	1	3	2	0	6	1.5
304	4	T	3.2	0	2	0	0	2	0.6
304	5	Q	3.59	0	0	0	0	0	0
304	5	R	4.09	0	0	0	0	0	0
305	1	A	2.92	1	1	0	0	2	0.7
305	4	B	3.75	0	0	0	0	0	0
305	4	G	5.26	0	1	0	0	1	0.2
305	4	J	6.27	0	0	0	0	0	0
305	5	C	3.52	0	0	0	0	0	0
305	5	D	3.65	0	0	0	0	0	0
305	5	E	2.73	0	0	0	0	0	0
305	5	F	4.16	0	0	0	0	0	0
305	5	H	2.13	0	0	0	0	0	0
305	5	I	4.96	0	0	0	0	0	0
306	2	B	2.05	1	4	2	0	7	3.4
306	2	C	2.2						
306	2	D	1.58	4	6	2	0	12	7.6
306	2	F	3.76	0	0	0	0	0	0
306	2	G	2.77	0	1	1	0	2	0.7
306	4	E	3.39	1	2	3	0	6	1.8
306	5	A	3.16	0	0	0	0	0	0
306	5	H	3.21	0	0	0	0	0	0
308	1	C	2.99	1	2	2	0	5	1.7
308	1	E	3.23	0	5	2	0	7	2.2
308	1	L	3.02	1	1	1	0	3	1
308	1	O	1.88	0	1	1	0	2	1.1
308	2	B	3.38	2	3	0	0	5	1.5

WMU	Stratum	Block	Area (km^2)	Bulls	Cows	Calves	UI	Total moose	Density (moose/km^2)
308	2	J	3.78	0	1	1	0	2	0.5
308	2	M	2.82	0	1	1	0	2	0.7
308	2	N	4.66	0	0	0	0	0	0
308	2	Q	3.49	2	6	1	0	9	2.6
308	4	A	3.16	0	0	0	0	0	0
308	4	F	1.97	0	0	0	0	0	0
308	4	H	3.57	0	1	0	0	1	0.3
308	4	K	2.85	0	0	0	0	0	0
308	4	P	2.54	2	5	2	0	9	3.5
308	4	S	3.73	0	1	1	0	2	0.5
308	5	D	2.93	0	0	0	0	0	0
308	5	G	3.57	0	0	0	0	0	0
308	5	I	2.26	0	0	0	0	0	0
308	5	R	2.95	0	1	0	0	1	0.3

Appendix 2. 2002 moose densities for each WMU by habitat stratum. Strata are ranked from highest density to lowest density within each WMU.

WMU	Stratum	# of blocks sampled	Mean moose density (individuals/km^2)	Standard deviation
302	2	6	1.8	2.33
302	4	8	1.0	1.13
302	5	4	0.7	0.67
303	4	1	0.5	NA
303	5	5	0.3	0.40
304	1	3	3.3	2.33
304	2	8	2.0	2.42
304	3	2	1.6	0.17
304	4	3	1.1	0.45
304	5	2	0	0
305	1	1	0.7	NA
305	4	3	<0.1	0.11
305	5	6	0	0
306	2	4	2.9	3.44
306	4	1	1.8	NA
306	5	2	0	0
308	1	4	1.5	0.55
308	2	5	1.1	1.00
308	4	6	0.7	1.40
308	5	4	<0.1	0.16

Appendix 3. Historical moose densities and bull: cow: calf ratio data summary, from 1975-1996 (after Quinlan 1998).

Management Unit and Year	Moose Density Per Square km. Of Range	Estimated Moose Population	Moose Population Structure	
			Bulls/100 Cows	Calves/100 Cows
WMU 302				
1975-76	0.7		21	58
1977-78	0.5		70	80
1979-80	1.1		22	44
1981-82	0.7		29	54
1983-84	0.5		13	28
1985-86	Not Surveyed			
1988-89	0.7		25	53
1990-91	1.1	292	48	43
1993-94	1.1	297	82	80
1995-96		238	31	26
1998		160	38	22
2002	1.0	271	53	34
WMU 304				
1981-82	1.1		19	70
1983-84	1.3		17	66
1985-86	0.7		17	40
1988-89	0.5		16	40
1990-91	0.8	268	13	40
1993-94	1.3	434	19	71
1995-96		550	30	37
1998		567	25	37
2002	1.8	598	34	41
WMU 305				
1977-78	0.4		I/S	I/S
1979-80	0.5		I/S	I/S
1981-82	0.2		I/S	I/S
1983-84	0.2		I/S	I/S
1985-86	Not surveyed			
1988-89	0.1		I/S	I/S
1990-91	Not surveyed	n/a		
1993-94	0.1	38	20	40
1995-96		103	27	36
1998		49	13	25
2002	0.1	17	I/S	I/S
WMU 306				
1975-76	1.2		42	42
1977-78	0.8		11	44
1979-80	2.2		12	58
1981-82	1.1		11	47
1983-84	1.3		27	50
1985-86	0.5		I/S	I/S
1988-89	1.0		10	35
1990-91	0.8	206	41	59
1993-94	0.7	178	33	40
1995-96	0.7	182	29	62
1998		247	19	31
2002	1.1	140	46	62
WMU 308				
1981-82	1.8		33	50
1983-84	1.1		9	51
1985-86	0.6		15	27
1988-89	0.9		16	44
1990-91	1.1	271	41	61
1993-94	1.9	468	25	52
1995-96	1.6	411	44	44
1998		478	40	27
2002	0.8	285	29	43

I/S – Insufficient Sample

Appendix 4. Program Cost Analysis: an itemized account of operational expenditures associated with implementation of the 2002 Southern Foothills moose survey program.

a)	Aircraft	
	Helicopter (Charter – Bighorn Helicopters Ltd.) 35.1 hr @ $785 per hr	$27,553.50
	Fuel (3468 l)	$2601.00
b)	Staff	
	Aerial survey crew (6 crew x 3.5 days x $250/day)	$5,250.00
	Data analysis and report preparation (8 days x $250/day)	$2,000.00
TOTAL PROGRAM COST		$37,384.50

Note: Flying time was financed through the Alberta Conservation Association.